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ENABLING ACTIVITIES, PROFESSIONALS' EXPERIENCE
AND RESOURCE RELATIONSHIPS:
THE EFFICACY OF ENTREPRENEURIAL
AND BOOTLEGGING ACTIVITIES*

by

Todd R. La Porte

Internal Working Paper No. 105

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UNIVERSITY OF CALIFORNIA, BERKELEY

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Contemporary professional life has become organizational life as well. As this occurred, the capacity for professionals to be the predominant determiners of the manner in which they carried out their role has declined in the face of organizational demands for coordination and control in achieving organizational goals.¹ Tension over who should shape the directions and conduct of professional activity has changed the connotation of two professional activities long embedded in that role. Within the parlance of organized professional life, the activity of seeking a sponsor for your work becomes entrepreneurship, and bootlegging is the term attached to going beyond the formal stipulations of the contract made with the organization and/or sponsor in order to conduct professional work as it develops in unforeseen directions. Both these activities are familiar to professionals and have become a part of the language of organized professional life.² They describe activities explicitly intended to enable professionals to carry on their work in the face of organizational demands.

This paper explored the efficacy of engaging in these enabling activities in three research organizations of varied context. Particular emphasis is on the relationship between the resource relationships of the organization with their sponsors and the effects of enabling activity on experiencing valued professional conditions.

Conceptual Background

For the purposes of this paper, our basic conception of formal organization rests on the assumption that all organizations are "open and partial" systems.³ Formal organizations are "open" to their environment through dependencies upon other organizations and are sensitive to

changes in their relationships with these organizations. They also attempt to structure these relationships so that the degree of uncertainty or contingency they face is reduced or at least not increased. They are "partial systems" in the sense that members are not dependent upon the employing organization in many aspects of their lives, rather entering and leaving organization roles in the course of each day and week. Thus, organizations are effected by their environment, through "official" interaction with other organizations and in the attitudes carried into the organization by individual members. In research organizations both these sources of environmental effect are evident: first, in the relations between laboratory management and important sources of funds and objectives, and second, in the values and expectations technical professions have which reflect the attitudes of the larger scientific and engineering communities.

All formal organizations engage in exchanges with other organizations in efforts to insure a continuous flow of financial resources, personnel with requisite skills, legitimacy of operations, etc. Without sustained attention to maintaining flows of resources from the environment, any organization will suffer diminished activity and vigor.

These exchanges are important aspects of the numerous dependency relationships between a research organization and significant organizations in its environment. The degree of dependence may vary from almost complete dependence to almost none and is directly related to specific resources. In some cases, dependency is reversed and research organizations engage in exchanges with others in which they

are clearly a dominant party with regard to particular resources. The case of specialized research in space related sciences just after the flight of the Russian Sputnik or a monopoly over a particular breakthrough technology such as transistors illustrates this relationship.

The character of these dependency relationships are instrumental in stimulating variations in both structural arrangements and behavioral patterns of organizational members. The more critical the organization perceives a particular resource and the more monopoly commanded over that resource by another organization, the more dependent the first organization upon the outside source. This generally results in increased notice paid to the outside organization and its conditions for supplying the resource. Responses to this relation are evident in the attention of executives to this problem and in possible structural reorganization to assure continued surveillance and adjustment to the source of resources. In general, we assume that shifts in the relationships between an organization and its sources of important resources will result in subsequent changes in member behavior and internal structure. For example, as the amounts of funds available for research from one source of support diminishes we would expect increased search activity for other sources, and possibly internal rearrangements in the responsibilities of administrators and scientists for types of work, sectors of search, etc.

Outside pressures are translated into administrative procedures and policies intended to mesh their effects with ongoing technical and management processes. Internal reward structures may also be altered, sometimes quite unintentionally, to encourage behavior consistent with

both ongoing and altered activities in the organization. These administrative processes and reward structures form significant aspects of the organization's requirement for individual members. They are important stimuli in the development of managerial and technical professional behaviors intended to increase the probability of accomplishing organization goals and realizing professional values. Thus, there are various "tactics" employed by both managers and professionals in coping with the demands placed on them by each other and arising from the organization's environment.

As the environmental context varies from one organization to another we would expect the efficacy of similar tactics to vary. We also expect that the efficacy of a particular set of tactics would vary within an organization as its environmental context is changed. In research organizations, this means that the capacities of managers to reward or punish the activities of scientists and engineers is affected by the kinds of environmental constraints faced by the organization, and the ability of individual professionals to reduce their dependency on the organization. Technical professionals may find that activities once readily rewarded by managers or peers no longer elicit that response. It also means that managers are often faced with scientists who are able to develop sources of research funding for their work based predominantly on personal competence rather than on their employment by the organization. Furthermore, when faced with formal constraints they feel are inappropriate, professionals may engage in activities they believe to be in the interests of research and the organization, such as informally carrying on types of research not specified or sanctioned in contract stipulations. From the view of the professional, these activities are enabling

mechanisms which increase the likelihood that he will be able to do those things he is interested in doing. In a sense, the latitude he has to engage in enabling activities make it possible to enlarge his "professional space" through increasing his capacity to define and carry out his research activities.

Enabling Activities and Sources of Support

This paper is concerned specifically with the efficacy of opportunities to carry on enabling activities and effects of variations in the number of funding sources on the apparent utility of doing so. Our interest is also limited to research scientists, the members of R and D organizations probably most crucial in accomplishing organizational objectives. The two enabling mechanisms are entrepreneurial activities, i.e., attempting to persuade agencies outside the organization to provide funds for the scientist's own work, and "bootlegging" or non-formal research, i.e., carrying on work that is not formally specified in the scientist's grant or contract. These are two rather familiar mechanisms professionals employ to counter organizational pressures which they perceive as diverting them from professionally rewarding work.

Whether or not engaging in these enabling activities results in positive experiences for technical professionals who employ them is related to the degree: 1) conditions valued by professionals are met in the organization, and 2) managers are able to respond in ways that provide positive conditions for professionals who engage in enabling activities. In the organizations included in this study, a number of professionally and organizationally related conditions were perceived by scientists to be more generally available than they felt was important.

For these conditions, opportunities to engage in enabling activities should have little differential effect. If there is not a perceived discrepancy between levels of expectation and experience for a particular condition, then employing enabling activities to increase this experience is not very likely. However, a number of other conditions were relatively highly valued by scientists as a group and not generally available in the organization or were available at about the same proportion as they were valued.⁴ The way managers allocate resources and differentially deal with individual scientists in these situations is an important aspect of the efficacy of engaging in enabling activities. One significant factor in the capacity of managers to respond to scientists is the character of the relationship with the sources of funds and resources available to the laboratory.

In organizations with limited funds, for example, active technical entrepreneurs are likely to receive greater attention from managers about decisions they are considering which may effect the scientist's work. On the other hand, in laboratories with an assurance of funds entrepreneurial activities may receive little extraordinary organizational notice. Likewise, research organizations with limited flexibility in spending its resources may tacitly reward professionals who spend part of their time engaging in research work not formally agreed to in the laboratory contract. This, in fact, may be necessary if the laboratory is to retain its highly skilled scientists, particularly when unfettered research remains part of the scientific ethic.

In a number of ways, then, managers' responses to professional demands are shaped by the overall abundance of resources and the number

of potential sources of resources available to the organization. The organizations represented in this study were all relatively assured of resources in the short run. There was a sense of optimism about the future, and managers had a relatively high capacity to meet a variety of demands of their professionals. In this sense, the laboratories were "good" ones, had quite respectable reputations and scientists were highly disposed to stay with them. In this situation, the number of sources of support could have a definite effect on the efficacy of the two enabling activities in the defining the relationships of scientists to their organization.

In organizations which regularly obtain support from a number of agencies, we expect that scientists would find seeking funds for their own research a more sensible tactic in enabling them to overcome organizational constraint. Enriching the organization with funds generated by scientists satisfies both organizational and research needs and is generally regarded as legitimate by managers in these types of organizations.⁵ We also expect that in multi-source labs, bootlegging, generally regarded as somewhat illegitimate by managers, would be less necessary and receive less positive managerial regard.⁶ In laboratories that had only one source of funds, as in a military laboratory, entrepreneurial activities are likely to be more difficult and, on the whole, less effective in gaining outside support. Therefore, entrepreneurship would return less positive results and bootlegging would be a more attractive tactic for enabling certain kinds of professional activities.

In the three research organizations in this study, many scientists had opportunities to engage in both these enabling activities.⁷

Those who could employ them both had dual mechanisms which could be applied as needed in expanding their "professional space." Each activity could be used in situations most appropriate in the particular organization. These scientists, then, had more likelihood of shaping their immediate conditions in ways that will enable them to experience valued professional conditions.

Hypothesis I: Scientists having a high degree of opportunity to engage in both enabling activities, are more likely to perceive relatively high frequency of experiencing valued professional conditions than scientist who have opportunities to engage in only one or neither of these enabling activities.

When large number of scientists have opportunities to engage in both enabling activities, the effects of one or the other activity on their other experiences is difficult to determine. Therefore if we are interested in the differential effects of resource relationships among the three organizations examination of the experience of those who can engage in only one activity is necessary. We expect that as the number of sources of funds declines the efficacy of entrepreneurial activities would also decline and bootlegging would become a more attractive and effective tactic. Incidentally, since bootlegging is a direct and immediate action one takes in relation to his research, although a somewhat illegitimate activity (often legally prohibited), we would not expect it to have as great an overall effect as entrepreneurship in altering professionals' experience. Entrepreneurial activity is an indirect way of changing the basis of immediate work conditions by providing resources which reduce overall dependency upon the organization.

With reduced dependency, the professional is more likely to structure his situation so he will experience those conditions he values.

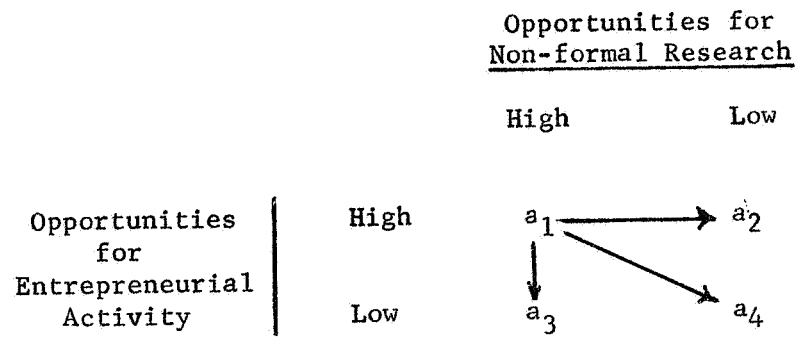
Hypothesis II: As the number of available sources of organizations resources declines, opportunities to persuade sponsors to fund a scientist's work declines in its association with perceptions of frequently experiencing valued professional conditions, and doing research work not formally specified in the contract increases in its association with frequently perceived positive professional conditions.

Corollary I: The conditions remaining associated with entrepreneurial activities are those that require direct expenditure of resources and/or managerial attention; such as consultation with managers about decisions, allocation of funds, personnel, equipment and organizational recognition for research performance.

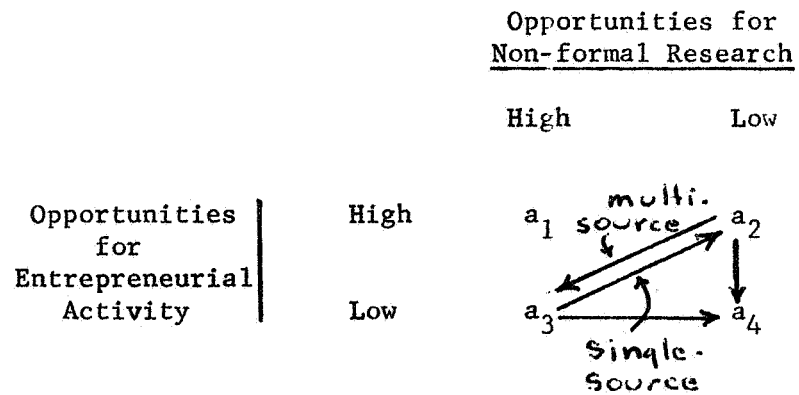
Figure I summarizes the predictions indicated by these hypotheses. Schematically, $pr(a_i)$ represents the probability that scientists in cell a_i perceived a high frequency of opportunity to experience conditions C_j . From Figure I, Hypothesis I, we obtain the following predictions as indicated by the arrows representing signs of inequality "greater than": $pr(a_1) > pr(a_2)$; $pr(a_1) > pr(a_3)$; $pr(a_1) > pr(a_4)$ for C_j . Figure I, Hypothesis II, summarizes the relationships between those scientists perceiving only opportunities to engage in one or the other enabling activity and those who perceive they can do neither. It indicates that in multi-source organizations: $pr(a_2) > pr(a_3)$; $pr(a_2) > pr(a_4)$; for C_j ; and in single source organizations, $pr(a_3) > pr(a_2)$; $pr(a_3) > pr(a_4)$; for C_j . Hypothesis I is the most unequivocal predicting that these relationships will hold for all the valued conditions. Hypothesis II and its corollary indicate that as the number of funding sources vary some conditions remain

Figure I

Hypothesis I



Hypothesis II



associated with entrepreneurial activities while others will be more strongly associated with non-formal or bootlegging activities for those able only to engage in one enabling activity.

(Figure I about here)

Method

Data gathered to test these and number of other hypotheses about professionals in complex research organizations were taken from three research and development laboratories on the West Coast. Each of the laboratories was almost totally supported by government contracts though under different legal relationships with funding agencies. The Industrial Research Laboratory (IRL), the R and D unit for a large aerospace firm, derived their support from a number of government agencies. The Non-profit University Laboratory (NUL) was an appendage of a university engaged in work primarily for one government agency though had several sources of funds from various branches within the agency. The Military Defense Laboratory (MDL) was related to a single Division within a Branch of one of the three major military services. Units within the lab were directly related to counterpart groups within the military division. All labs were about the same size with some 4000 employees and all worked on roughly the same types of technical problems.

Questionnaire and interview data were gathered using random stratified samples of scientists, engineers, technical managers and business-type administrators. Common questionnaires and interviews guide were used, with minor modifications determined by the language of the laboratory. Table I shows the size of the scientist sample in each

and the breakdown of scientists perceiving opportunities to engage in both activities, one or the other or neither activity.

Table I
Scientists' Opportunity To
Engage in Enabling Activities

Frequent Opportunities for:	Scientists in					
	Industrial Research Laboratory		Non-Profit University Laboratory		Military Defense Laboratory	
	%	(n)	%	(n)	%	(n)
Both Activities	62	(68)	49	(51)	54	(42)
Entrepreneurial Only	14	(15)	6	(6)	5	(4)
Bootlegging Only	16	(18)	30	(33)	30	(23)
Neither	8	(9)	15	(16)	10	(8)
TOTAL	100	(110)	100	(106)	99	(77)

Fifteen items specifying professional and/or organizational conditions were analyzed as dependent variables associated with the combinations of perceived opportunities to experience the enabling activities. Five items were deleted on the grounds that 1) there was a relatively lower degree of importance attached to these items by scientists in each organization; and 2) there was substantially higher opportunity perceived to experience them than they were valued.⁸ When this is the case for a particular condition there would be relatively ample opportunity for scientists to have their expectations met with regard to it. Items were included which referred to conditions relatively highly valued by scientists in each organization and perceived as available at or below the

level each group placed importance upon them.

These items were grouped into three clusters, representing types of conditions relevant to the professions. The first included three conditions representing professional values, i.e., opportunity to keep up to date on new information, opportunity to conduct research contributing to scientific knowledge (basic research), and opportunity freely to select your own research. The second cluster included those conditions defining the organizational context of research work. They were opportunity to conduct research free from day-to-day supervision, consultation from managers about decision that affected scientists' work, opportunities for research promotion, and organizational recognition by name for research accomplishments. Finally, there were three items related to levels of resources available to scientists, including adequate levels of funds, technical assistance (personnel) and equipment.

To test these hypotheses, operational indicators of $pr(a_i)$ were required.⁹ This was done by constructing a ratio v/n where v is the number of scientists in cell a_i reporting they had frequent opportunities to experience some C_j , and n is the number of scientists in cell a_i as determined by the combination of enabling activities they report having frequent opportunities to experience. For the purposes of calculating, $pr(a_i) = v/n$. Table 2 summarizes the data relating the combinations of enabling experiences to ten valued conditions within the three laboratories. As we noted above only those items finally included were those for which the difference between the percentage of scientists in the organizations who attached high importance or value to the conditions $C_j(v)$, and those who reported frequent opportunities to do so, (Ex) , was near or greater than

zero, $V-Ex=0$. Also included in Table 2 are the V_i and Ex_i for the included conditions.

Findings

Based on reasoning concerning the use of both enabling opportunities to increase the probability of experiencing valued professional and organizational conditions, the following prediction was made:

1. In each organization, for each category of enabling activity experience E_i , e_1 = opportunities to engage in both, e_2 = entrepreneur only, e_3 = bootleg only, e_4 = neither, and for each valued condition C_j , $j = 1, 2, 3, \dots, 10$, it is the case that

$$pr(a_1)e_1c_j > pr(a_2)e_1c_j$$

$$pr(a_1)e_1c_j > pr(a_3)e_1c_j$$

$$pr(a_1)e_1c_j > pr(a_4)e_1c_j \text{ for } i = 1, 2, 3, 4$$

Data for testing this hypothesis, as well as the one to follow, are presented in Table 2, where the probabilities for $v/n = pr(a_i)$ are displayed.

Table 3 contains the results for the first hypothesis.

(Table 2 about here)

In calculating the statistical significance of this result, two ways of interpreting the data are possible. Each comparison of single probabilities can be counted as an observation. Each observation could be in one of two forms, T or F, for some 90 cases, (three organizations, ten conditions with three comparisons each.) In this instance, our prediction is true for 79 out of 90 observations. This is an highly significant result, using the binomial test method. However, our hypothesis was more specific in its meaning. Our prediction was that

TABLE 2

Probabilities of Frequent Opportunities to
Experience Valued Professional and Organizational Conditions

ORGANIZA- TION	ENABLING EXPERIENCE	PROFESSIONAL VALUES				ORGANIZATIONAL CONTEXT				ORGANIZATIONAL RESOURCES			
		Keep up To date	Basic Research	Select Research	Day-to-Day Freedom	Consulted By Managers	Research Promotion	Organiz. Recog.	Adequate Funds	Adeq. Tech. Assistance	Adeq. Lab Equipment		
INDUSTRIAL RESEARCH LABORATORY (N=110)	Both (68) (n)	.94	.94	.76	.81	.69 ^a	.82	.87	.56	.67		.64 ^a	
	Ent. (15)	.93	.80	.60	.87	.60	.80	.80	.29 ^a	.60		.60	
	Boot (18)	.78	.67	.33	.89	.17	.67	.50	.33	.33		.33	
	None (9)	.67	.44	.11	.67	.33	.55	.44	.22	.50 ^a		.50 ^a	
	(V-Ex)	.90-.89 .01	.85-.84 .01	.78-.62 .16	.85-.82 .03	.84-.49 .35	.81-.77 .04	.72-.76 -.04	.98-.46 .52	.91-.59 .32		.88-.57 .31	
NONPROFIT UNIVERSITY LABORATORY (N=106)	Both (51) (n)	.86	1.00	.88	.96	.55	.75 ^b	.88 ^b	.82	.50 ^c		.90 ^c	
	Ent. (6)	.67	.83	0	.67	.50	.67	.83	.50	.75		.83	
	Boot. (33)	1.00	.97	.79	.94	.28 ^a	.67	.58	.82	.51		.78 ^a	
	None (16)	.75	.56	.13	.56	.25	.62	.56	.50	.50		.80 ^a	
	(V-Ex)	.91-.88 .03	.94-.91 .03	.78-.69 .09	.88-.72 .16	.63-.58 .05	.86-.70 .16	.74-.73 .01	.80-.75 .05	.90-.51 .39		.90-.84 .06	
MILITARY DEFENSE LABORATORY (N=77)	Both (42) (n)	.93	.93	.71	.90	.61	.86	.95	.95	.67		.93	
	Ent. (4)	1.00	.75	.25	.50	.50	.50	.75	.75	.50		1.00	
	Boot. (23)	.96	.74	.39	.70	.43	.56	.70	.59 ^a	.60		.96	
	None (8)	.62	.37	.13	.75	.25	.62	.75	.50	.62		.75	
	(V-Ex)	.95-.90 .05	.95-.81 .14	.79-.53 .26	.82-.80 .02	.79-.48 .31	.86-.73 .13	.60-.84 -.24	.80-.79 .01	.94-.64 .30		.92-.91 .01	

^a = one response less than total "n" in enabling experience category

^b = two responses less than total

^c = three responses less than total

^d = V is the percent of scientists in the lab who felt this condition was "quite" to "very" important to them; Ex is the percent who reported "quite" to "very" frequent opportunity to experience them.

$pr(a_1)$ would be higher than $pr(a_2)$, $pr(a_3)$ and $pr(a_4)$, for C_j . Therefore, each cell in Table 3 will be interpreted as an observation, with a run of T, T, T required to support the prediction. In this instance, 24 out of the 30 observations are in the predicted form.

(Table 3 about here)
It is possible for each observation to have one of 8 forms, (the first condition, "keep up-to-date," for each organization illustrates three such forms.) If the opportunity to engage in both enabling activities had no effect on the probability of experiencing valued professional or organizational conditions, we could expect that all eight forms would have equal probability of appearing. Therefore, our null hypothesis is that each form would occur with an equal probability of 1/8. The chances of validating the prediction is 1/8 and the likelihood of invalidating is 7/8. The significance level of only 6 disconfirming cases can be calculated using the binomial test for determining the significance level of such distributions.¹⁰ Doing so, shows an extraordinarily high significance level ($Z = 10.6$), or $p > .00003$ of falsely asserting prediction 1 to be true. On the basis of this analysis, Hypothesis I is validated.

Testing the hypothesis dealing with the effects of variations in the resources relationships of the organizations upon the efficacy of engaging in enabling activities is more complicated. Our prediction was

2. For categories of enabling activity experience

E_1, e_2 = entrepreneur only, e_3 = bootleg only,
 e_4 = neither, and for each valued condition C_j ,
 $j = 1, 2, 3, \dots, 10$, and for numbers of funding
sources S_k , $k = 1, > 3$, it is the case that

$$\begin{aligned} 2.1 \quad pr(a_2)e_{i c j s_k} &> pr(a_3)e_{i c j s_k} \\ pr(a_2)e_{i c j s_k} &> pr(a_4)e_{i c j s_k} \text{ for } i = 2, 3, 4 \\ &\quad k = > 3 \end{aligned}$$

Test of Hypothesis I

Frequent Opportunity to Experience Valued Conditions

	PROFESSIONAL VALUE				ORGANIZATIONAL CONTEXT						ORGANIZATIONAL RESOURCES		
Organization	Keep Up To Date	Do Basic Research	Select Research	Day To Day Freedom	Consulted By Manager	Research Promotion	Organiz. Recog.	Adequate Funds	Adeq. Tech. Assistance	Adeg. Lab. Equipment			
<u>IRL</u> $\text{pr}(a_1) > \text{pr}(a_2)$ $\text{pr}(a_1) > \text{pr}(a_3)$ $\text{pr}(a_1) > \text{pr}(a_4)$	T T T	T T T	T T T	F F T	T T T	T T T	T T T	T T T	T T T	T T T			
<u>NUL</u> $\text{pr}(a_1) > \text{pr}(a_2)$ $\text{pr}(a_1) > \text{pr}(a_3)$ $\text{pr}(a_1) > \text{pr}(a_4)$	T F T	T T T	T T T	T T T	T T T	T T T	T T T	T F T	F F F	T T T			
<u>MDL</u> $\text{pr}(a_1) > \text{pr}(a_2)$ $\text{pr}(a_1) > \text{pr}(a_3)$ $\text{pr}(a_1) > \text{pr}(a_4)$	F F T	T T T	T T T	T T T	T T T	T T T	T T T	T T T	T T T	F F T			

and

$$\begin{aligned}
 2.2 \quad & \text{pr}(a_3)_{e_i c_j s_k} > \text{pr}(a_2)_{e_i c_j s_k} \\
 & \text{pr}(a_3)_{e_i c_j s_k} > \text{pr}(a_4)_{e_i c_j s_k} \text{ for } i = 2, 3, 4 \\
 & \quad \quad \quad k = 1
 \end{aligned}$$

Since controlling for the effects of engaging in both enabling activities is required to determine the effects of only one such activity, Table 4 includes only the results of testing for the relations between a_2 , a_3 , and a_4 probabilities noted in Figure I, Hypothesis II.

(Table 4 about here)

Using each cell in Table 4 as one observation, there are only two forms of distributions supporting prediction 2.1. If entrepreneurial activity is more associated with valued conditions in multi-source organizations, then T, T, T, and T, T, F support the prediction. This results in a probability of 1/4 confirming this part of the prediction, and 3/4 of disconfirming it. Table 4 shows only two disconfirming observations for the IRL, the multi-source laboratory. The probability of falsely asserting prediction 2.1 to be true is $p > .00003$ ($Z = 4.01$). Prediction 2.2 requires that $\text{pr}(a_3) > \text{pr}(a_2)$ and $\text{pr}(a_3) > \text{pr}(a_4)$. Using the same procedure as above for the single source laboratories, only two forms support the prediction, F, T, T, and F, F, T.¹¹ Again, there is a probability of 1/4 for confirmation and 3/4 for disconfirmation. Only data from one of the two single-source laboratories appears to support prediction 2.2. NUL data shows only 4 disconfirming observations, which is support for the prediction at the $p > .0057$ level of significance. Thus, hypothesis 2 is only partially supported. The military laboratory does not meet the predicted pattern of responses. Reasons for this, other than sample size, will be explored below.

Table 4

Test of Hypothesis II

Frequent Opportunity to Experience Valued Conditions

Organization	PROFESSIONAL VALUES			ORGANIZATIONAL CONTEXT					ORGANIZATIONAL RESOURCES		
	Keep Up To Date	Do Basic Research	Select Research	Day To Day Freedom	Consulted By Manager	Research Promotion	Organiz. Recog.	Suff. Funds	Adeq. Tech. Assistance	Adeq. Lab. Equipment	
IRL <u>Multi-source</u> pr(a ₂)>pr(a ₃) pr(a ₂)>pr(a ₄) pr(a ₃)>pr(a ₄)	T	T	T	F	T	T	T	F	T	T	
	T	T	T	T	T	T	T	T	T	T	
	T	T	T	T	F	T	T	T	F	F	
NUL <u>Single Source</u> pr(a ₂)>pr(a ₃) pr(a ₂)>pr(a ₄) pr(a ₃)>pr(a ₄)	F	F	F	F	T	F		F	T		
	F	T	F	T	T	T	T	F	T	T	
	T	T	T	T	T	T	T	T	T	F	
MDL <u>Single Source</u> pr(a ₂)>pr(a ₃) pr(a ₂)>pr(a ₄) pr(a ₃)>pr(a ₄)	T	T	F	F	T	F	T	T	F		
	T	T	T	F	T	F	F	T	F	T	
	T	T	T	F	T	F	F	T	F	T	

Finally, the logical extension of our reasoning suggests that opportunities to engage in any or both enabling activities will be associated with a higher probability of experiencing valued conditions than if neither activity can be experienced. Following the same procedure as above, there are 12 disconfirming observations out of 30, which returns a probability of falsely asserting the prediction to be true of $p > .00003$.

We have attempted to develop a strict test for our predictions discounting the fact that each organization has at least one category of enabling experience for which there are less than 10 cases. This was most critical for the MDL, with one category of only 4 cases, and one with only 8. It is reasonable to expect more disconfirming observations on the basis of sampling error when the number of cases is this small. However, there were not enough to materially alter our findings, except possibly for the second part of prediction 2. Only four cases of "entrepreneurial opportunities only" in MDL could have a sizeable effect on calculations of $pr(a_2)$ compared to $pr(a_3)$. Notably, the smallest sample sizes appear in the "entrepreneur only" categories for the two single-source laboratories, while the "bootleg only" categories for these labs is considerably higher than that category in the multi-source lab, IRL. This adds weight to Hypothesis II, for it suggests that bootlegging activities in the UNL and MDL was recognized as a necessary behavior whether one was an entrepreneur or not.

Discussion

In general, the pattern of experiences technical professionals have in these three organizations are in the direction predicted. Clearly the opportunity to engage in both enabling activities is associated with considerably higher probabilities of experiencing other valued professional

and organizational conditions. The relatively high percentage of scientists reported that they can do both is, in a sense, an indication that these laboratories afford a good deal of latitude in conducting their scientific affairs. Substantial numbers of scientists in each organization can apparently mix legitimate and "illegitimate" activities to enlarge their professional space. However, the efficacy of each activity in this process does seem to vary, at least partially, in response to the constraints occasioned by the number of funding sources available to the labs.

But before we discuss in more detail the substantive patterns in the data, a word about the relationship between "bootlegging" and "freedom from supervision" in doing scientific work is in order. The other professional and organizational conditions treated as dependent variables can be thought of as conditions which are likely to be effected by the consequences of being an entrepreneur or a bootlegger. That is, the implicit causal relationship is from the enabling activity to the condition. For example, the conclusion is implicit that if a scientist has frequent opportunities to persuade sponsors to fund his work, it will result in higher chances for having more funds and more frequent consultation from managers about the decisions they make which effect the scientist's work. In the case of "freedom from supervision", and its relationship to bootlegging, however, these may very well be reversed. That is, freedom from supervision may be necessary in order to bootleg. The data in Table 2 suggests this may be the case, for there is an apparently high correspondence between experiencing high levels of this freedom and being a bootlegger only. However, there is also some ambiguity in the same cells. If freedom from supervision is a necessary condition for bootlegging, then we would expect that those who engage in

both activities and those who can bootleg only would be equally high in this organizational condition. This is the case the scientists in NUL, though less so for those in IRL and clearly not the case for those in MDL. Finally, if we substitute freedom from supervision for bootlegging in the construction of our independent variable, rather different results follow. If they were the same variable the results should be reasonably the same. It can also be argued the other way round, that in an organizational environment which provides general opportunities for enabling activities, engaging in bootlegging results in the feeling of less supervision. In final analysis, if we deleted this condition altogether it would not materially change the results of our main predictions.

As we already have noted, Hypothesis I appears to be validated and holds regardless of the organizational context. However, the number of funding sources does appear to have an effect. In the laboratory which has multiple funding sources, IRL, bootlegging activities have little relative effect on most conditions. The three in which it might be argued that it does are all activities furthest removed from managerial view, i.e., "keep-up-to-date," and "freedom from supervision." The latter is largely a function of the reduced capacities of managers to supervise large numbers of very skilled specialists.

The pattern of analysis for the two "single-source" laboratories is another matter. The laboratory which receives its funds in a block from the agency to dispense internally, that is, NUL, follows the pattern predicted quite well. Five, possibly six, conditions appear to be more strongly associated with bootlegging activities than with entrepreneurial ones. This includes all the professional value conditions rather markedly; one, possibly two, organizational context conditions, and one resource condition. The ones that remain associated with entrepreneurial activities

are those most visible to and capable of direct influence by managers, i.e., consultation from managers, organizational recognition, adequate technical personnel assistance and lab equipment. This follows, mainly, the corollary following Hypothesis II. Two final notes regarding the NUL data, first, the data on technical assistance needs to be seen in the context of a very tight limit on the number of personnel the lab could employ. At the time of the study, the lab had grown rapidly, was larger than the supporting agency would allow, and was undergoing some overall personnel shrinkage. Therefore, management had very consciously tried to equalize the loss in personnel across all groups. I think the quite flat distribution in that cell reflects this policy. Second, the relationship between bootlegging and funding was an unexpected one. Initially, we had expected entrepreneurial activity to be associated with this condition. However, it is possible that being able to bootleg on other funds results in the perception that there is adequate funding for what a scientist wants to do, not because he has legitimated funds for that activity, but that he is able to work on projects that interest him under the guise of current funded project definition. This is only speculation, however, and we do not have data to test this notion. There is a slight tendency in this direction in IRL, but the reverse in MDL.

The military lab is somewhat anomalous in this study. It was classified as a single-source lab, though we knew it was different in its relations with funding agencies than NUL. Funds were allocated to scientific groups within the lab basis of three-way negotiations between the group leader, technical counterpart division within the military branch and laboratory management. This meant that each year, group leaders knew their proposals for future work would be reviewed by management and one

or two men in Washington who were responsible for monitoring their type of technical activity. It was single-source funding with vengeance! The data show that this type of funding relationship produced sufficiently different constraints for MDL that they did not follow the pattern for single-source labs as we expected.

Engaging in both activities was quite strongly associated with positive conditions for eight out of the ten, only "keeping up-to-date" and "adequate lab equipment," generally experienced by all personnel, did not follow that expectation. There were, however, the only conditions in the lab with high overall experience. This suggests that in group-single-source funding situations both enabling activities are required for positive experiences. Difference between the "both" category and the others is relatively quite marked, for all the condition clusters. Of course, this could be an artifact of the small sample sizes in the "entrepreneur only" and "none" categories, but we believe this would be the case in other group-single-source laboratories as well.

Finally, the analysis in this paper implicitly assumes that managers' attitudes about and capacities to influence various professional and organizational conditions were relatively constant. This is not likely to be the case, though it is quite probable that many of the conditions valued by scientists are also thought to be valuable for them by their managers. It is likely that in the cases where managers do not share the same general level of expectation about the value of these conditions, bootlegging activities would increase in efficacy, particularly for those who can only bootleg. It is also likely that when managers have relatively direct control over particular conditions and value them for scientists, entrepreneurial activity will return positive manager behavior in allocating

resources, etc.¹² However, this does not appear to be particularly relevant for scientists who can engage in both activities.

In complex organizations where control over specialists is increasingly control-by-exception, there is likely to be substantial latitude for technical professionals to feel themselves able to seek support from outside agencies, as well as follow their work in the directions they feel appropriate, regardless of managerial attitudes to the contrary. This is the burden of Hypothesis I. Relationships with the sources of support do make a difference largely for the tactical employment of these activities and particularly for those who feel themselves unable to engage in one or the other.

Research and development organizations can be viewed as contending with the conditions of complexity, technical uncertainty within and environmental uncertainty without. In so far as the pattern of behaviors explored in this paper are characteristic of other organizations confronting these conditions it signals what can be interpreted as a decline in managerial control in the traditional sense. It also suggests that the technical professional role, as it adapts to a continuing organizational milieu, will come to include more formal consideration of the tactics and strategies of entrepreneurial and non-formal research activities.

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1. See for example, S. Marcson, The Scientist in American Industry (New York: Harpers, 1961); W. Kornhauser, Scientists in Industry: Conflict and Accommodations (Berkeley: University of California Press, 1962); T. La Porte, "Conditions of Strain and Accommodations in Industrial Research Laboratories," Administrative Science Quarterly, 10 (June, 1965), pp. 21-38; W. Evans, "Superior-Subordinate Conflict in Research Organizations," Administrative Science Quarterly 10 (June, 1965), pp. 52-64; and M. Abrahamson, ed., The Professional in the Organization (Chicago: Rand McNally 1967).

2. See H. M. Vollmer, "Professional Adaptation to Organizations," in H. M. Vollmer and D. L. Mills, eds., Professionalization (Englewood Cliffs, N. J.: Prentice-Hall, 1965), pp. 275-282; and D. S. Greenberg, "'Bootlegging:' It Holds a Firm Place in Conduct of Research," Science, 153 (August, 1966), pp. 848-849 and Kornhauser, op. cit. p. 65.

3. The literature drawn upon for much of the following section views the organization as a system and relationship within and outside it characterized by exchange. See P. Blau, Exchange and Power in Society (New York: Wiley, 1964); R. Katz and R. H. Kahn, The Social Psychology of Organization (New York: Wiley, 1965, esp. ch. 2 and particularly J. D. Thompson, Organizations in Action (Englewood Cliffs, N. J.: Prentice-Hall, 1967) from which a number of concepts are reenforced.

4. The underlying assumption is that scientists perceiving less chance to experience a valued condition than they expect will result in an increased level of tension due to this discrepancy. In efforts to reduce this tension-discrepancy scientists are expected to use those enabling mechanisms to do so. For an excellent discussion of the limits of tension reduction assumption in the social sciences see, P. Sperlich.

5. Over 50% of the managers in the multi-source laboratory, an industrial aerospace unit, felt it was important for scientists to seek outside support. This was also true for the other laboratories, although interview data from the multi-source lab greatly amplified the intensity of this feeling for those managers.

6. Interview data from managers regarding bootlegging reenforced this interpretation. In the industrial lab, the managerial position was that "there is no bootlegging here. It is against the law." This was in the face of a self reported 78% of the scientists sampled who indicated opportunities to bootleg. In the only lab we asked the question directly

of managers, the non-profit university lab, only 32% of the managers felt bootlegging was an important activity for scientists to experience.

7. See Table I.

8. The items dropped included questions concerning scientists' opportunities: (1) to be promoted into management positions; (2) to do applied research; (3) to attend professional meetings; (4) to publish research findings; and (5) to implement research findings.

9. In the development of the form and method of test I am indebted to Michael Shapiro for considerable suggestions and W. Riker and P. C. Ordeshook, "A Theory of the Calculus of Voting," American Political Science Review, LXII (March, 1968), pp. 34-40, for the particular method of presentation.

10. The clearest discussion of this method of test I have found is S. Siegal, Nonparametric Statistics (New York: McGraw-Hill, 1956), pp. 36-42.

11. In an effort to simplify Table 4 the same probability titles have been used for each organization. This means that for the two single-source labs, the form supporting the hypothesis will be the negation of the directions indicated by the probability titles for the multi-source lab. Therefore, the two forms supporting the prediction for the single-source labs is F,F,T and F,T,T.

12. Data were collected from managers concerning these conditions. Analysis and reporting of these results will be done in the near future.